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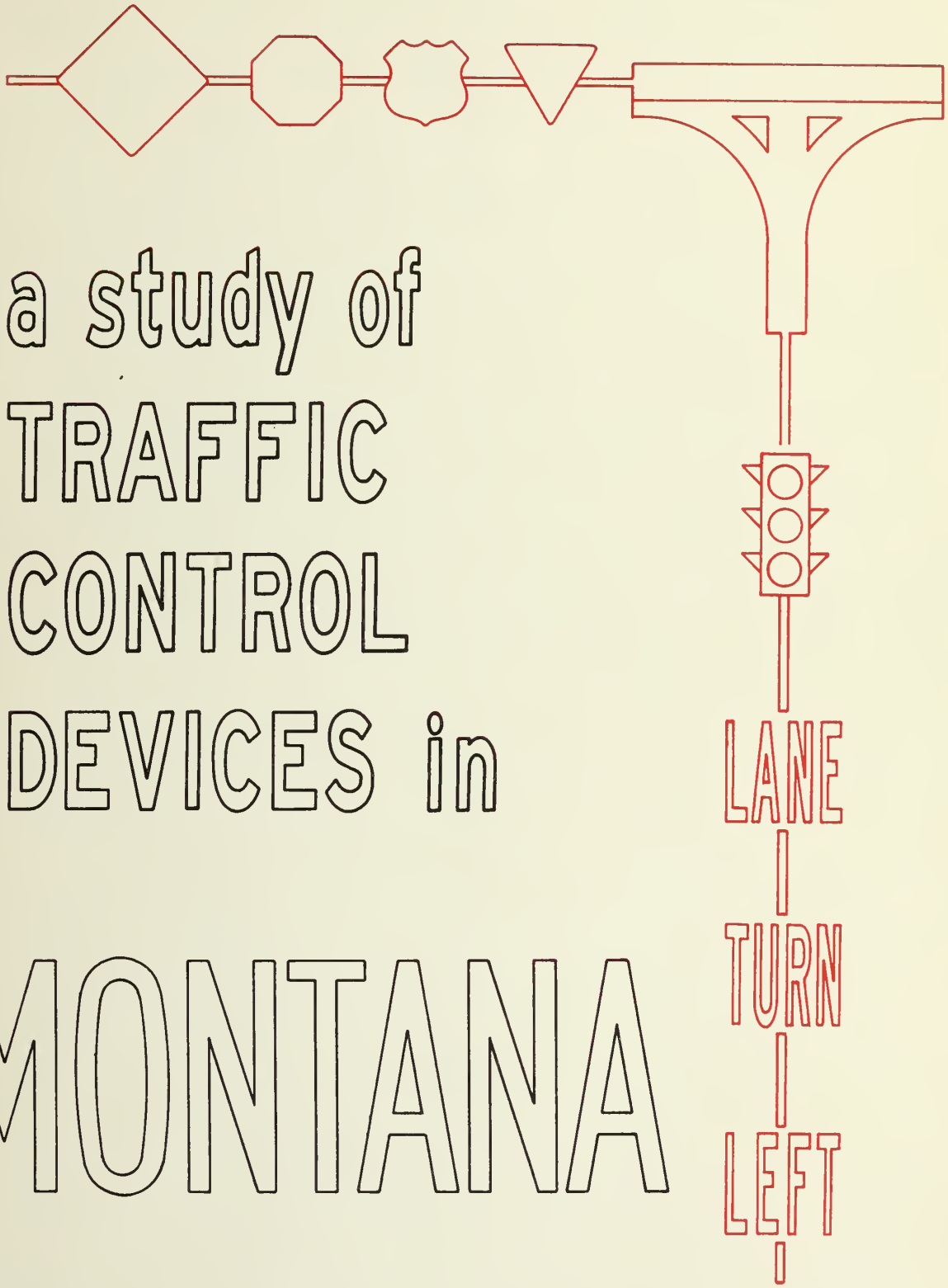
MONTANA STATE HIGHWAY COMMISSION



a study of TRAFFIC CONTROL DEVICES in MONTANA

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a study of
TRAFFIC CONTROL DEVICES
in
MONTANA

Conducted by the
TRAFFIC ENGINEER'S OFFICE
MONTANA STATE HIGHWAY COMMISSION
in co-operation with the
U.S. DEPARTMENT of COMMERCE
BUREAU of PUBLIC ROADS
July 1, 1965

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SUMMARY

This study is based upon a field inventory of the existing traffic control devices on the Primary Highway System in Montana. The study has been made to determine the adequacy of the existing devices as compared to modern standards. Signs, signals and the route numbering system are the three major portions of the study.

The study indicates that the majority of the signs and signals need to be modified to conform with the standards as set forth in the "Manual on Uniform Traffic Control Devices for Streets and Highways". A need is also shown for a Montana Uniform Manual that would cover more specifically those situations that are unique to Montana.

Most of the necessary modifications to the traffic control devices would qualify for financial assistance from the Federal Government thru the Federal-aid Highway program. This is evidenced by the fact that four projects are currently under contract with Bureau of Public Roads participation, covering 543 miles of the Primary System.

It is estimated that the complete program to up-grade the traffic control devices, including miles posts, on the Primary System as of late 1968, will cost 3.3 million dollars.

Part I presents the sign modernization needs at an estimated cost of 2 million dollars.

Part II covers the need for mile posts throughout the State at an estimated cost of $84,600.

Part III includes traffic signals and flasher needs at an estimated cost for complete modernization of 1.2 million.

Part IV points up the complexity of our existing route numbering system and recommendations are given for eliminating coincident numbering.

INTRODUCTION

The need for a nation-wide system of uniform traffic control has been accelerated by the Interstate Highway construction and the State's adoption of the 1961 Edition, "Manual on Uniform Traffic Control Devices for Streets and Highways." The safety, convenience and economy of operation on a modern highway is dependent upon the quality of traffic control devices regardless of the excellence of design of the highway itself.

Many miles will automatically be brought up to date in connection with the extensive new construction presently underway or planned as part of the Interstate System. Other areas of the State, however, must continue to depend on existing facilities. The Primary and Secondary System accounts for more than 11,400 miles of Montana's existing road network and shares the bulk of our highway traffic. These existing highways and the highways to be constructed in the future, must be operated to provide the greatest possible degree of safety and efficiency. Uniform traffic control will contribute directly to obtaining these goals.

Traffic control devices are the responsibility of all levels of government and it is essential that all agencies recognize the importance of uniformity. Two organizations, The American Municipal Association and the National Association of County Officials, joined the National Joint Committee on Uniform Traffic Control Devices in 1960, and will materially aid in the modernization of local roads and city streets.

The Bureau of Public Roads has made Federal aid available to assist the states in a program of standardization and/or modernization of traffic control devices. Policy and Procedure Memorandum 21-15, issued by the Bureau of Public Roads on June 16, 1964, sets forth the policy and provisions by which the Bureau will participate.

Full compliance with the standards of the Uniform Manual will be required. Exceptions for a research study may be allowed for nonconforming traffic control devices when official recognition and approval has been given by the Director of the Office of Research and Development. Also, certain existing signs and signals having remaining useful life and closely conforming to present standards may be retained.

1. Signs and route markers in good condition that meet new standards as to shape, color, reflectorization and symbols or wording and have legend dimensions not varying more than twenty-five per cent from that of the standard.

2. Similar conditions control the replacement or modernization of signals. Those installations that provide a tolerable order of standardization may be retained.

Areas in which traffic control device modernization may qualify for Federal participation are defined as follows:

1. Signs and signals on new highways or major reconstruction of existing highways built with participating Federal funds.

2. Relocation, adjustment or replacement and necessary additional signs and signals on an existing highway, even though the highway is not otherwise to be improved.

3. Pavement and curb markings on new or old construction, whether the first or a subsequent marking installation to comply with the standards of the Uniform Manual.

4. Installation of new or adjustment of existing minor islands and other channelizing devices when this work is coincident to the installation of signs or signals and needed for conformance with the Uniform Manual.

PPM 21-15 also outlines the necessary procedures relative to needs for improving traffic control devices, thus assuring orderly cooperation in a State-Federal program of modernization.

1. Inventory each device now in place and evaluate its compliance with the Uniform Manual.

2. Prepare summaries and needs estimates including removals and additional new devices as necessary for compliance with the Manual.

3. Examine the existing signed route numbering system critically for possible simplification, elimination, and consolidation of routing throughout the total system.

The overall objective is the attainment of basic uniformity in the visible features and functioning of traffic control devices on all Federal Aid highways by the end of Calendar Year 1968.

SCOPE OF MONTANA'S SURVEY

In mid-1962, the State Highway Engineer, in cooperation with the Bureau of Public Roads, instructed the Traffic Engineer's office to proceed with a pilot inventory of traffic control devices in order to evaluate the needs of a modernization program on the Primary System.

Two test sections were selected, one through mountainous terrain in the western section and the other through the rolling plains of eastern Montana. A total of 409 miles were inventoried in these sections.

A preliminary report was prepared from the data gathered on the test sections. The report revealed that a very small percentage (6.5%) of the rural signs inventoried met all standards of criteria as set forth in the Uniform Manual. More than two-thirds of the signs inventoried were below standard mounting height and/or of undersize dimensions.

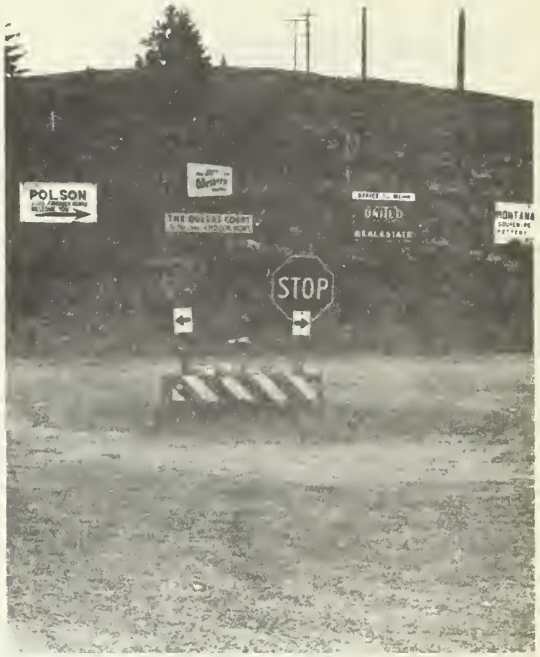
Early 1963, saw further development of the program. The first F 9999 project was being prepared for letting during the summer and the remaining 5500 miles of the Primary Highway System were being inventoried.

The F 9999(1) contract covered 118.5 rural miles of US 93 from Missoula to Kalispell. The contract consisted of 530 new sign assemblies, 288 signs to be removed, plus the delineation and advisory speed marking of those curves warranting such markings. Speed zones were rechecked and new ones established as warranted.

The second F 9999(2) project is currently under contract. It covers some 348 miles on US 12, from Garrison Junction easterly to a junction with US 10, near Forsyth. The job includes one major urban area, Helena, and several smaller ones. Modernization of the signals on the route through Helena, are included in the project.

State field forces and the State Sign Department in Helena, are accomplishing F 9999(3) and (4), totaling 77 miles. A cost comparison between these two shorter routes and the longer routes now let to contract will help determine how future projects of this type will be established.

Non-standard yellow Stop sign low mounting.



Advertising signs distract from official regulatory devices. Use of directional arrows below these official signs is not recommended

Standard Stop sign urban area.

Standard Stop sign rural area.

PART I

SIGN NEEDS

Field crews selected from Highway Department personnel in each District were given detailed instructions concerning the type of information needed and the manner in which it was to be recorded. Physical data was recorded manually on 29,988 signs along 4,700 miles of the Primary Highway System and then coded on IBM cards for sorting and analysis by computer equipment.

Results of this analysis indicated 436 sign units advertise commercial products and services, or give information about churches, social clubs and organizations, a number much lower than expected and which would indicate a high degree of control and cooperation between the advertising public, and the District Offices. However, if, after further investigation, these 436 non-official signs are indeed on highway right-of-way, they are to be removed or relocated by the owners.

For this study the Primary Highway System was classified as Urban or Rural. Urban sections are defined as those portions of the Federal Aid System within the limits of incorporated towns and cities. The remaining sections are classified as rural.

There are 29,552 official sign units on the 4,700 Primary miles. Twenty-five percent of these are within incorporated city limits and 75 percent in rural areas. For comparison, this is a density of 58 signs per mile in urban areas and 5 signs per mile in rural areas.

Only 3,559 units or 12 percent met minimum acceptable standards. These would require no further action beyond normal maintenance. The remaining 25,993 units should be replaced, re-positioned, or removed. An additional 10,431 new sign units and 28,810 delineators will be needed to adequately sign the inventoried mileage and the important approaches to it. See Chart I.

The estimated dollar costs to modernize the existing sub-standard signs, plus necessary additional units in both Urban and Rural areas would be $2,026,971, including engineering costs. See Chart II.

SIGN MODERNIZATION PROGRAM

To complete the sign modernization of the remaining primary routes in the State, it is essential that a definite program be followed.

Multiple mounting as indicated here is generally not acceptable. Guide sign legend is too small.

Guide signing urban area.

It is presently planned to modernize the larger trans-state routes first. Each numbered route will be broken into sections varying from 50 to 150 miles in length in an effort to assure convenient groups of work for contract purposes. A continuous route would be uniformly re-signed within a reasonable time. For instance, US Routes 93 and 12 will be those routes to be completed first for their entire length.

The shorter in-State routes would be the last to be re-signed, although in some cases, it may be more economical to include some of the shorter routes with a trans-state route contract.

An earnest effort will be made towards substantially completing the sign modernization by the end of 1968. To accomplish this goal, it will be necessary to expand the signing section of the Traffic Engineer's Office.

With approximately 4,700 miles of Primary Highway remaining to be re-signed, it is estimated that 4,418 man-days will be required for the preparation of plans. With July, 1968, as the target date for completion of the planning, it would be necessary to assign nine men, with no other duties, to F 9999 projects. This estimate of required manpower is based upon 21 man-days per month and 94 man-days per 100 miles of re-signing.

The above estimate of completion includes only the sign-modernization. Signals, channelization, and other traffic control devices necessary for the completion of the program still have to be considered.

The "Junction" plate is a component of the advance route marker assembly & should not be used at a route junction. Separate mounting for "Airport" sign is suggested.

The cardinal direction plate ("South") should have been mounted over the route marker. Separate mounting for "Airport" sign is suggested.

Information signs by other official agencies should be located in conformance with the Uniform Manual.

The black and white rectangular "Cross Walk Ahead" is non-standard. A yellow diamond warning series should have been used.

An out-dated stop sign that has more than served its useful life.

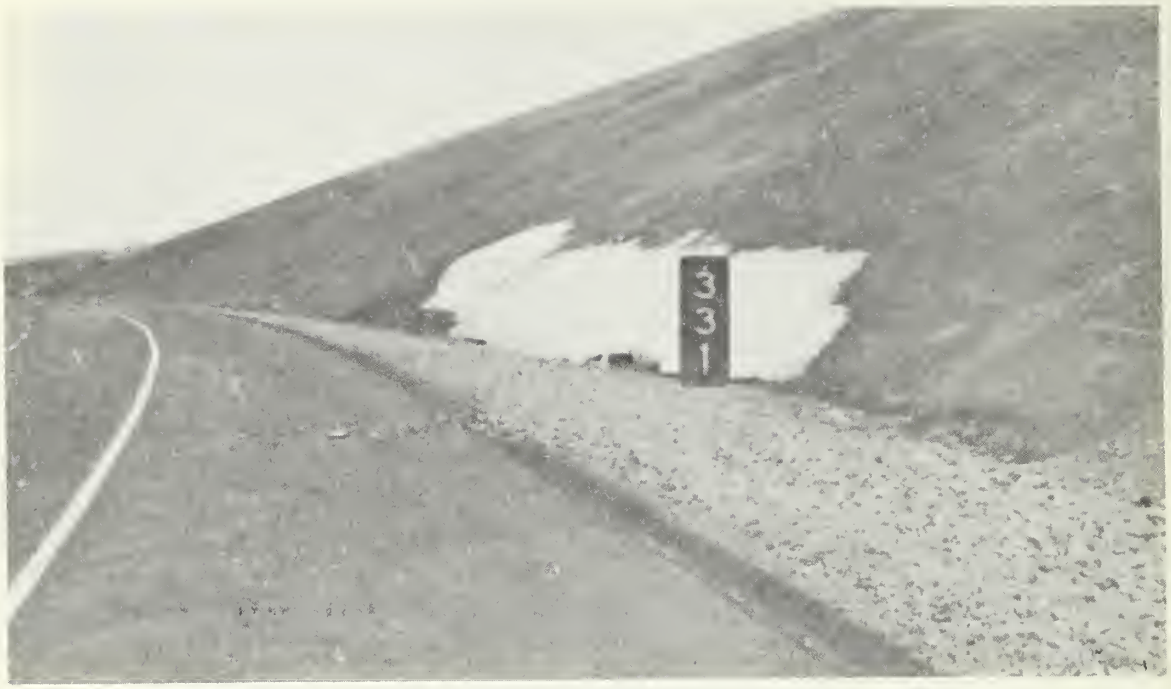
Guide Signing should not be used in conjunction with route markers.

Substandard guide signing.

Modern highspeed guide signing.

Conformation route markers need no directional arrows. Cardinal direction sign "south" should be mounted above the route marker.

Standard conformation route markers with cardinal direction plates.



Typical mile posts as used on Montana's Interstate system.

PART II

MILE POSTS

In the process of setting up the sign inventory and the pilot F 9999(1) project, it became evident that a considerable amount of time could be spent assembling the various road projects in order to prepare a base layout for locating the traffic control devices and related items. There also is an ever increasing demand that a more exact method be developed in Montana for the purpose of identifying locations of accident and emergency incidents and to aid in highway maintenance and servicing.

For these reasons we strongly recommend an immediate program for the mile marking of the entire Primary System. The use of mile posts as required on the Interstate System has proved their value. Many items of importance are presently tied to mileage along a certain route; bridges are presently located in such a manner and this could be easily extended to include culverts, signs, railroad crossings and intersections.

With the ever increasing emphasis on highway accident research, this one area alone would account for the savings of many man-hours. Accident locations are presently tied to any physical feature in the immediate area, "Smith Ranch Turn-off" may be a good location tie for a local resident or patrolman, but it means nothing to anyone outside the area. This is especially true in a state as large and open as Montana.

Maintenance forces would find many uses for mile posts. Location of signs to be repaired, roadway maintenance and many other items and incidents could be easily located and referenced in an accurate manner. Maintenance reports of any type would be more readily understood and of increased value to interested parties.

The highway driver uses the mile post to assist in estimating his progress and as a means for identifying the location of emergencies.

It is recommended that the panels and their location with respect to the roadway follow the "Manual on Uniform Traffic Control Devices". Design would include a simple panel with a 4 inch letter Mounting on <u>one side</u> of the roadway would be sufficient for two-lane highways.

Cost would be nominal in comparison to the benefits received. It is estimated that each panel, complete with post, would cost $10.00. Location and erection would cost an additional $5.00. Since there are 4,000 miles of Primary highway, excluding that mileage to be replaced by Interstate, the estimated overall cost would be $84,600, including engineering.

Channelized intersection with volume density, full traffic actuated, two-phase signalization.

Residential intersection controlled with a three-dial fixed time interconnected signal system.

PART III

ELECTRICAL DEVICES

Until as recently as 1957, the vast majority of signals in Montana have been installed and maintained by the towns and cities which they serve. Too often these signals were erected with little regard for warrants or even a tolerable order of standardization as specified in the Uniform Manual. A widespread belief that traffic signals are the answer to all traffic control problems has often resulted in the neglect of a proper engineering study. Hence, poor designs and inadequate maintenance have led to potentially dangerous intersections where some other type of traffic control would provide safer and more efficient service.

Between 1957 and 1963, the State Highway installed traffic signals at 37 intersections on the Federal Aid System. These generally were at isolated locations coincident to new or revised roadway construction. The necessary warrants and design criteria as set forth in the Uniform Manual were followed in detail.

Since 1963, a greater emphasis has been placed on the more sophisticated designs and an enlarged program of more than one-half million dollars has been spent on modern up-to-date signal installations, particularly traffic-actuated interconnected systems either at new locations or as replacements of antiquated existing devices. The majority of installations have occurred on our Primary highways, however, similar locations on the Secondary System are not being overlooked where warrants can be met.

Flashers, not as specifically covered on warrant requirements as traffic signals, present a problem best resolved by limiting future requests and restricting their installation to cases of proven need. Those now in existence on the State Highway System are not all ill-conceived, though some are probably not justified and should be removed. Those remaining installations, which predominantly function as school or pedestrian crosswalks, should be modernized to provide the protection attributed to them.

Field data of existing electrical devices were recorded as a coincidental part of the state-wide inventory on the Primary System. Information on similar devices located on the Secondary System was obtained from District Office field investigations. More detailed data regarding each urban location was requested from city governments known to have operating signal devices.

Urban intersections controlled by a single spanwire and one fixed time signal indication.

TRAFFIC SIGNALS

The combined data from the above inventories, investigations and traffic counts at the affected intersections indicated 24 percent of the total signal locations met minimum warrant and design requirements of the Uniform Manual. There are a few borderline cases that approached the volume warrants and should normally increase sufficiently to meet the minimum volume warrants within 3 to 5 years. These installations, however, would not qualify as adequately designed, and must, therefore, be modernized as part of our present program. The remaining locations which neither meet nor reasonably approach the required traffic volume warrants for signal control should be removed and standard intersection signing installed.

Predictable problems that will arise when seeking approval from city governments for removal of unwarranted signals may prove to be a practical warrant for their continued existence, if modernization through the use of the following were provided:

1. Actuated controls at isolated installations which would more equitably distribute the time between the highway and city streets.

2. Interconnect to provide for synchronized timing.

3. Additional signal faces to provide a minimum of two faces for each approach to the intersection.

4. Larger faces at locations where approach speeds are high.

Implementing these design improvements would help correct some of the inherent hazards and needless delays resulting from the use of signals at low-volume intersections.

There are 179 signalized intersections on Montana's Federal Aid System. Of these, only 43 met minimum warrants and design requirements. The remaining 136 locations should be removed or modernized either with completely new installations or revised in part with additional equipment at an estimated expenditure of $816,000. This cost is based on an average estimate of $6,000 per signalized intersection as determined from 1964 and 1965 bid prices for such work. See Chart III.

In most instances existing equipment would contribute little toward modernization when completely revamping the installations.

A detailed analysis of each signal location will not be com-

Urban intersection controlled by three-phase full traffic actuated, double indication and pedestrian push-button "walk-don't walk".

Urban intersection controlled by two-phase full traffic actuated, double indication and pedestrian push-button "walk-don't walk".

pleted immediately, but worked out in entirety as the programming of the Traffic Control Device Modernization progresses.

An additional 24 unsignalized intersections will meet the minimum traffic warrants for signalization within the next three years. These should be considered prior to 1968, at an estimated cost of $168,000, based on an average cost of $7,000 per intersection for new work. See Chart III.

In total, $1,180,000 would be necessary for traffic signal modernization, including engineering.

FLASHERS

Flashers of all types totaled 131 on the State Highway System. Flashing beacons installed at the approaches to communities numbered 36. A number of these could be discontinued as there appeared to be no particular hazard involved. Where speeds are deemed high by the local residents, an engineering study establishing a reasonable speed zone with appropriate signing would better rectify the condition than the inadequate flashers.

Desired effectiveness of 32 flashers at minor street intersections are doubtful where traffic and pedestrian volumes are lower than minimum signal warrants. Another 35 existing intersection flashers are probably justified where Federal Aid highway systems junction at the outskirts of communities and particularly in rural areas, where approach speeds may be high.

There are 28 flasher controlled school or pedestrian crossings on the Primary Highway System. Twenty-six of these are deemed substandard, not adequately lending the protection attributed to them, and should be considered for modernization.

Two were recently installed by contract from State Highway designs and included two color heads (12" red and 8" yellow), double indication for each approach and pedestrian push-button control. Pavement markings and standard signs were also included.

The substandard school and pedestrian flashers, though they may not now meet pedestrian volumes, should be rebuilt to similar standards of the two above. These specifications are not to be construed as hard and fast designs for revisions or new installations, but only as good proven examples.

Modernization in line with the above examples for 26 existing school and pedestrian crossings is estimated at $62,400, based on an average expenditure of $2,000 per location, including costs of engineering. See Chart III.

Major junction in urban area controlled by three-phase full traffic actuated signalization.

Major junction at midtown intersection controlled with three-phase full traffic actuated signals and pedestrian push-button "walk-don't walk".

Many varying designs make up the majority of electrical flashing beacons used at school crossings.

Mid-block crosswalk flasher without pedestrian push-button.

Intersection crosswalk flasher with pedestrian push-button.

PART IV

ROUTE NUMBERING

This portion of the study was undertaken to determine the extent of multiple route designations on Montana's Primary Highways.

Revision of the present numbered system was sought through two basic objectives. (1) A critical examintation for effective ways of reducing existing coincidental route mileage through simplification, and (2) a proposal of route numbering standards for future highway designations.

There are 1,649 miles of the primary system carrying two or more route numbers coincidently, as shown on Figure 9. Included thereon are the proposed Interstate routings, which will add nearly 1100 miles of multiple route-marker signing to the present US 10, 91 and 87, signed routes, thus enlarging the existing problem to the traveling public through a profusion of route-marker assemblies at junctions and unnecessary misunderstanding of multiple route designations on a single highway.

Even more acute are areas within urban centers and built-up subdivisions where 2, 3 or 4 routes converge on a city.

In many areas the complexity in route signing could be rectified to a large extent by instituting the recommendations proposed herein to effectively reduce the present mileage having more than one route number and establishing policy standards for future route numbering.

A definite program will be required to implement the necessary changes of policy and simplification. Cooperation between the Highway Commission, city governments and highway "route promotion associations" will be of the utmost importance for effective results.

In addition to the convenience and clarity eminating from a route numbering simplification program, an economic benefit would result in any decrease of multiple route signing duplication by correspondingly lower highway signing costs.

Referenced below is the proposed policy standard used as a basis for the recommended route number changes suggested in this study and designed for continued continuity of future route designations.

> A.A.S.H.O. pamphlet "Purpose and Policy in the Establishment and Development of United States Numbered Highways", dated January 1, 1959. See Figure 8.

Multiple route marker assembly ground mounted.

Multiple route marker assembly overhead guide sign.

Following are two additional areas not specifically covered in the A.A.S.H.O. established policies and their inclusion, as a part of the above, sufficiently broadens the policy necessary to fulfill Montana's needs as determined from this study.

a. Montana designated route numbers will not be carried coincident with U.S. numbered routes. When a state route joins a U.S. route, the state route number will be dropped until such a time as it leaves the U.S. numbered route.

b. Two or more state route numbers will not normally be carried coincidently.

Adoption of the suggested policy standard and additions would be a profound help to all parties concerned with a simplified yet adequate numbering system designed to enhance the safe and expedient movement of motor vehicles throughout our State.

Recommendations designed to reduce coincidental route-marker mileage resulting from this study are listed in a three-step proposal.

1. Eliminate Montana 789 and US 312 route numbers from the system. See Figure 10.

   a. Montana number 789 could be deleted from the numbering system, as it travels coincident with U.S. routes through Montana.

      This route travels from Nogales, Arizona, to Sweetgrass, Montana. It is a state numbered route throughout its entirety and is coincident with other routes from beginning to end, except for a short distance in southern Wyoming.

      Removal of this route number in Montana, will simplify signing in Billings, Roundup, Lewistown and Great Falls, as well as at several major junctions with other Primary Routes.

   b. The designation US 312 could be deleted from the numbering system, as this route is located wholly within the State and does not cross the State border.

Multiple route marker assemblies.

U.S. 312 begins at Billings, travels east coincident with U.S. 10, to Miles City, and then continues south to its termination at the junction with U.S. 212, west of Broadus. The section between Miles City, and Broadus, could become an extension of Montana 22.

Deletion of U.S. 312 from the numbering system is in full accord with the A.A.S.H.O. pamphlet "Purpose and Policy in the Establishment and Development of United States Numbered Highways".

2. Discontinue State Route numbers 20 and 287, where they are coincident with U.S. or Interstate numbered routes. See Figure 11.

    a. Montana 20, could be discontinued over the center segment of its entirety as this portion is coincident with U.S. 89, beginning at the junction just north of Sun River through Great Falls and Lewistown, to the Grassrange Junction.

    On three portions of this segment, Montana 20 is coincident with two U.S. routes; one portion also includes a part of Interstate 15.

    The Great Falls area, where two of the above mentioned portions are located, presently has five routes converging upon it. Interstate 15 will soon add the sixth.

    Discontinuing Montana 20, over its center segment will effectively reduce the present complexity in the Great Falls area, at five major rural junctions and in the Lewistown area.

    b. The discontinuance of Montana 287, designation on four segments could be accomplished as they are coincident with U.S. routes in two instances, a U.S. and Interstate route in the third and with another Montana route in the fourth instance.

Which route did that sign say we were on?

One of various types of roadway delineators.

Route 287 is designated as a U.S. route from southern Texas, to Montana's southern border. A portion of this mileage is in coincident status with other U.S. routes.

Within Montana, Route 287 is a state route. Should the designation be changed to one of U.S. status, there would still be three segments coincidental with Interstate and/or other U.S. designations, over more than one-half its length, from the Montana-Idaho border to its termination at the Canadian line. Discontinuance of four segments of Route 287, beginning at Twin Bridges, to the Junction with Montana 41; Whitehall to Three Forks Junction; Townsend to Wolf Creek; and Choteau to the Canadian line, would relieve a major portion of Montana's duplicate route mileage, and simplify route signing at Helena.

3. Eventual elimination of U.S. 10, and U.S. 91 route numbers, as they will be coincidental throughout, upon completion of Interstate 90, 94 and 15, in Montana. See Figure 12.

   U.S. 10 and 91 are major Interstate designations, and both enter and leave the State at opposite borders. They have combined six segments presently coincidental with other U.S. routes.

   At least the three Montana Interstate route designations 90, 94 and 15, follow U.S. 10 and 91 alignments in states other than Montana. Within our borders the Interstate routings follow almost 100 percent these two U.S. routes.

CHART I

SUMMARY OF SIGNING AND DELINEATION NEEDS

DENSITY OF EXISTING SIGNS PER MILE URBAN = 57.5 RURAL = 4.9	SIGNS INVENTORIED	ACCEPTABLE	REMOVE NON-OFFICIAL	REPLACE	REPOSITION	REPLACE AND REPOSITION	REMOVE OFFICIAL	ADDITIONAL	TOTAL SIGNS TO BE MODERNIZED
URBAN (127 MILES)									
REGULATORY	3,843	269	-	2,114	846	307	307	808	
WARNING	439	4	-	228	22	27	158	141	
ROUTE MARKER	2,289	527	-	412	504	298	548	2,312	
GUIDE	214	122	-	75	0	17	0	128	
INFORMATION	261	13	-	115	5	13	115	29	
HAZARD MARKER	256	15	-	241	0	0	0	85	
NON-OFFICIAL	-	0	365	-	-	-	-	-	
URBAN SUB TOTALS	7,302	950	365	3,185	1,377	662	1,128	3,503	9,855
RURAL (4573 MILES)									
REGULATORY	4,782	478	-	1,817	861	670	956	1,435	
WARNING	4,313	129	-	2,070	173	776	1,165	388	
ROUTE MARKER	3,715	1,040	-	595	483	260	1,337	3,121	
GUIDE	1,488	223	-	595	0	149	521	714	
INFORMATION	1,887	132	-	981	170	377	227	906	
HAZARD MARKER	6,065	607	-	5,458	0	0	0	364	
NON-OFFICIAL	-	0	71	-	-	-	-	-	
DELINEATORS	0	-	-	-	-	-	-	28,810	
RURAL SUB TOTALS	22,250	2,609	71	11,516	1,687	2,232	4,206	35,738	55,379
COMBINED (4700 ±) TOTAL SIGNS	29,552	3,559	436	14,701	3,064	2,894	5,334	39,241	65,234

CHART II

SUMMARY OF COSTS TO MODERNIZE SIGNING & DELINEATION

ON THE PRIMARY HIGHWAY SYSTEM

DOLLAR COSTS PER MILE URBAN = $3,843 RURAL = $ 337 COMBINED = $ 431 URBAN (127 MILES)	REPLACE	REPOSITION	REPLACE AND REPOSITION	REMOVE OFFICIAL	ADDITIONAL	TOTALS
REGULATORY	$ 126,840	$ 30,456	$ 18,420	$ 921	$ 48,480	
WARNING	13,680	792	1,620	474	8,460	
ROUTE MARKER	9,064	7,560	6,556	1,644	50,864	
GUIDE	22,500	0	5,100	0	38,400	
INFORMATION	6,900	180	780	345	1,740	
HAZARD MARKER	3,615	0	0	0	1,275	
NON-OFFICIAL	(COST OF REMOVAL OR RELOCATION TO BE BORNE BY THE OWNERS)					
URBAN SUB TOTALS	$ 182,599	$ 38,988	$ 32,476	$ 3,384	$ 149,219	$ 406,666
RURAL (4573 MILES)						
REGULATORY	$ 109,020	$ 14,206	$ 40,200	$ 2,868	$ 86,100	
WARNING	124,200	2,854	46,560	3,495	23,280	
ROUTE MARKER	11,900	3,381	5,200	4,011	62,420	
GUIDE	178,500	0	44,700	1,563	214,200	
INFORMATION	39,240	2,805	15,080	681	36,240	
HAZARD MARKER	81,870	0	0	0	5,460	
NON-OFFICIAL	(COST OF REMOVAL OR RELOCATION TO BE BORNE BY THE OWNERS)					
DELINEATORS	0	0	0	0	122,442	
RURAL SUB TOTALS	$ 544,730	$ 23,247	$ 151,740	$ 12,618	$ 550,142	$ 1,282,477
COMBINED TOTAL (4700 M DOLLAR NEEDS	$ 727,329	$ 62,235	$ 184,216	$ 16,002	$ 669,361	$ 1,689,143
ENGINEERING COSTS						$ 337,828
GRAND TOTAL						$ 2,026,971

ESTIMATED SIGNAL AND FLASHER INSTALLED COSTS
BASED ON AVERAGE BID PRICES - 1964 & 1965

DESCRIPTION	UNIT PRICE	FIXED - TIME 1-DIAL Q.	FIXED - TIME 1-DIAL AMT.	FIXED - TIME 3-DIAL Q.	FIXED - TIME 3-DIAL AMT.	TRAFFIC ACTUATED SEMI Q.	TRAFFIC ACTUATED SEMI AMT.	TRAFFIC ACTUATED 2-DIAL Q.	TRAFFIC ACTUATED 2-DIAL AMT.	TRAFFIC ACTUATED 3-DIAL Q.	TRAFFIC ACTUATED 3-DIAL AMT.	PED FLASH MID-BLK TIME CLK Q.	PED FLASH MID-BLK TIME CLK AMT.	PED FLASH MID-BLK PUSH BTN Q.	PED FLASH MID-BLK PUSH BTN AMT.
VEH. SIG. 1 WAY, 1 COLOR	50											4	400		
VEH. SIG. 1 WAY, 2 COLOR	100													2	200
VEH. SIG. 1 WAY, 3 COLOR	150	8	1,200	8	1,200	8	1,200	8	1,200	9	1,350				
PED. SIG. 1 WAY, WALK-D'T WALK	150			8	1,200	4	600	8	1,200	8	1,200				
OVERHEAD GUY WIRE	70	2	140									1	70	1	70
2" COND. & 2-9 #14 CABLE	1,000			1	1,000	1	1,000	1	1,000	1	1,000				
SIG. POLE WITH MAST ARM	500			2	1,000	2	1,000	2	1,000	2	1,000				
COMB. SIG. & LTG. POLE/2 M A	650			2	1,300	2	1,300	2	1,300	2	1,300				
STRAIN POLE	750	2	1,500									1	1,500	2	1,500
FIXED TIME CONTRLR. - 1 DIAL	600	1	600												
FIXED TIME CONTRLR. - 3 DIAL	1,000			1	1,000										
SEMI-TRAFFIC ACT. CONTRLR.	1,250					1	1,250								
2 PHASE FULL ACT. CONTRLR.	2,000							1	2,000						
3 PHASE FULL ACT. CONTRLR.	3,000									1	3,000				
DETECTOR INSTL. MAG. OR LOOP	700					2	1,400	4	2,800	5	3,500				
CONTRLR. FOR FLASHER/TIME CLOCK	200											1	200		
PUSH BUTTON CONTRLR.	300													1	300
PUSH BUTTON	35													2	70
TOTAL			3,440		6,700		7,750		10,500		11,350		1,970		2,440
AVERAGE INSTALLED COST PER LOCATION			$6,000 to $7,000										$2,000		

CHART III

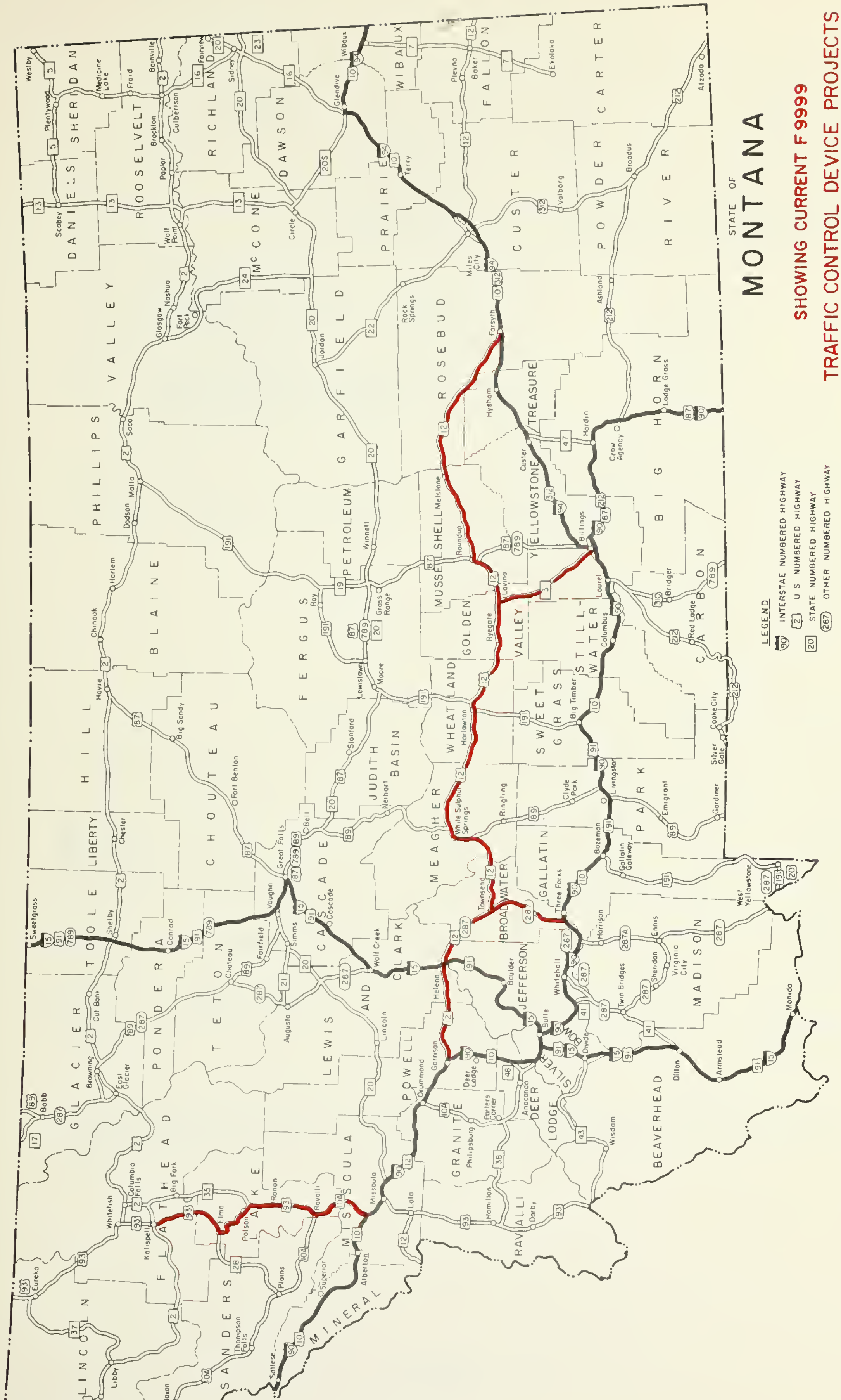
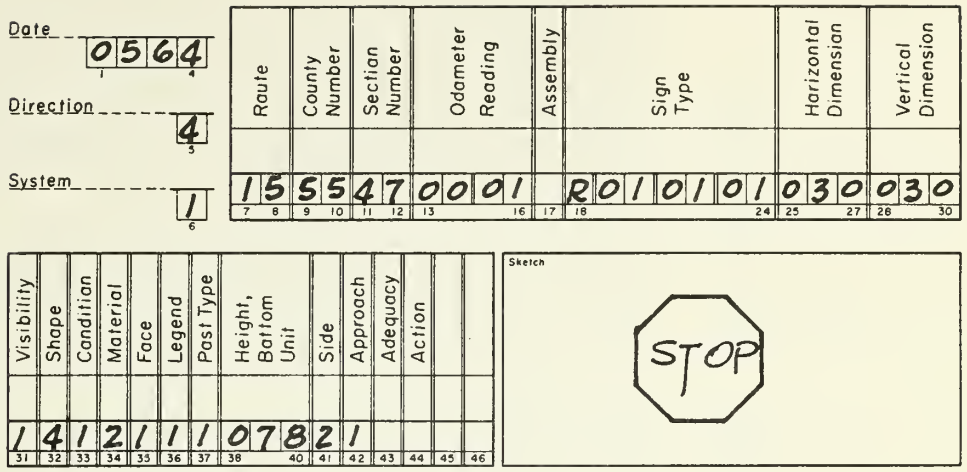

STATE OF
MONTANA
SHOWING CURRENT F 9999
TRAFFIC CONTROL DEVICE PROJECTS
LEGEND
INTERSTATE NUMBERED HIGHWAY
U S NUMBERED HIGHWAY
STATE NUMBERED HIGHWAY
OTHER NUMBERED HIGHWAY

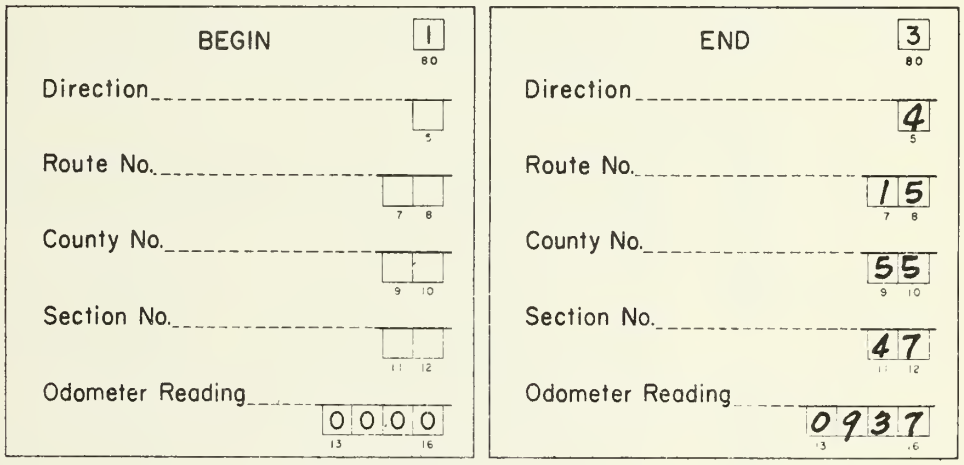
FIGURE 1

SIGN INVENTORY
DATA CARD



Field data card - One for each sign plate inventoried. The information was coded onto the card at the sign location.

SIGN INVENTORY
SECTION CHANGE CARD



The appropriate half of the card was filled out at the beginning of each inventory section and again on another card at the end of each section.

FIGURE 2

SIGN INVENTORY

DISTRICT 4

RTE.	SEC.	CO.	S	D	ASSEM.	TYPE	HOR.	VERT.	ODOM.	FACTOR	COR. MI.	MI. POST MI.	V	S	C	M	F	L	P	H	S
15	47	55	1	4	1	M 02 01 0	024	015	.30	1.0421	.083	347.023	1	2	1	1	1	2	3		2
15	47	55	1	3		X 01 01 0	024	008	.11	1.0421	.115	347.055	1	1	1	2	1	2	3	032	2
15	47	55	1	3		X 01 01 1	008	024	.11	1.0421	.115	347.055	1	1	1	2	1	2	3	032	1
15	47	55	1	4		X 01 01 0	024	008	.22	1.0421	.167	347.107	1	1	1	2	1	2	3	032	1
15	47	55	1	4		X 01 01 1	024	008	.22	1.0421	.167	347.107	1	1	1	2	1	2	3	032	2
15	47	55	1	4		N	024	024	.12	1.0421	.271	347.211	1	2	1	3	1	2	3	030	2
15	47	55	1	3		D	048	024	.32	1.0421	.333	347.273	1	1	1	3	1	2	3	058	1
15	47	55	1	3	6	M 04 01 01	021	015	.36	1.0421	.375	347.315	1	1	1	2	1	1	1	082	1
15	47	55	1	3	5	M 01 02 01	024	024	.36	1.0421	.375	347.315	1	2	1	2	1	2	1		1
15	47	55	1	3	4	M 06 02 01	021	009	.36	1.0421	.375	347.315	1	1	1	2	1	1	1		1
15	47	55	1	3	3	M 04 01 01	021	015	.36	1.0421	.375	347.315	1	1	1	2	1	1	1	082	1
15	47	55	1	3	2	M 01 04 01	024	024	.36	1.0421	.375	347.315	1	1	1	2	1	1	1		1
15	47	55	1	3	1	M 06 02 01	021	009	.36	1.0421	.375	347.315	1	1	1	2	1	1	1		1
15	47	55	1	4	2	M 01 07 01	018	024	.02	1.0421	.375	347.315	1	1	1	2	1	2	1	058	2
15	47	55	1	4	1	M 01 06 02	024	024	.02	1.0421	.375	347.315	1	1	1	2	1	1	1		2
15	47	55	1	3		R 04	018	024	.37	1.0421	.386	347.326	1	1	1	3	1	2	3	062	1
15	47	55	1	4		R 01 01 01	030	030	.01	1.0421	.386	347.326	1	4	1	2	1	1	1	078	2

DISTRICT TOTALS

	MILES	REG. SIGNS	WARN. SIGNS	RTE. MKR.	GUIDE SIGNS	INFO. SIGNS	HAS. SIGNS	OFF. SIGNS	ADV. SIGNS	ORG. SIGNS	UNKN. SIGNS	NON-OFF.	ALL SIGNS	SIG-NALS	UN-SIGNED
URBAN	4.079	104	11	74	13	7	10	219			1	1	220	5	
RURAL	185.420	128	95	114	60	35	424	856	3			3	859	3	
TOTAL	189.499	232	106	188	73	42	434	1075	3		1	4	1079	8	

FIGURE 3

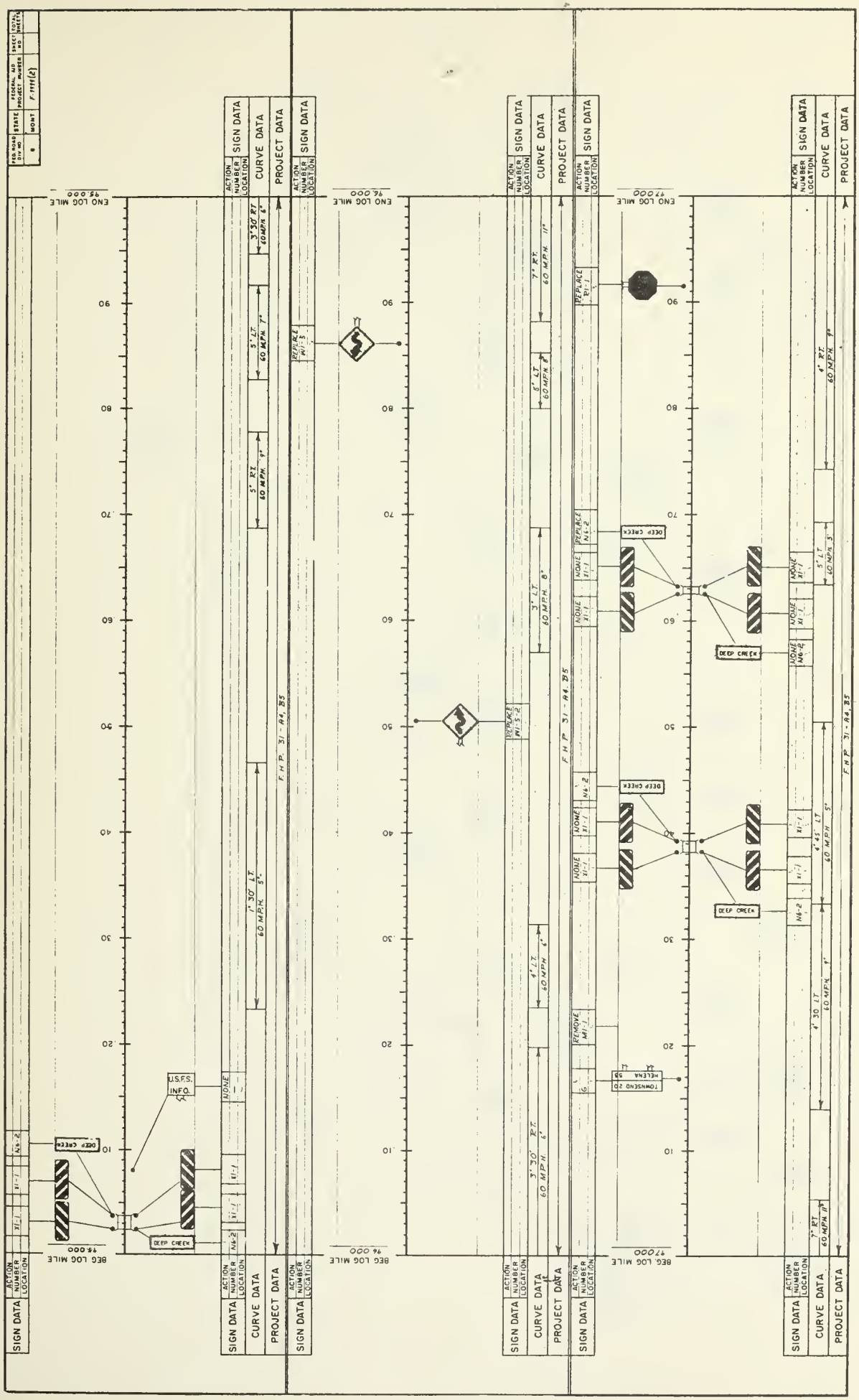

SIGN DATA
ACTION NUMBER LOCATION
CURVE DATA
PROJECT DATA
BEG. LOG MILE 74.000
END LOG MILE 94.000
F.H.P. 31 - #4, 85
DEEP CREEK
U.S.F.S. INFO.
TOWNSEND 20
HELENA 55
NONE
REMOVE
REPLACE
3° 30' RT. 60 MPH 6°
4° LT. 60 MPH 6°
3° LT. 60 MPH 8°
6° LT. 60 MPH 8°
7° RT. 60 MPH 11°
4° 30' LT. 60 MPH 5°
4° 45' LT. 60 MPH 5°
5° LT. 60 MPH 3°
4° RT. 60 MPH 3°
3° RT. 60 MPH 11°
5° RT. 60 MPH 8°
5° LT. 60 MPH 7°
3° 30' LT. 60 MPH 5°
3° 50' RT. 60 MPH 8°

FIGURE 4

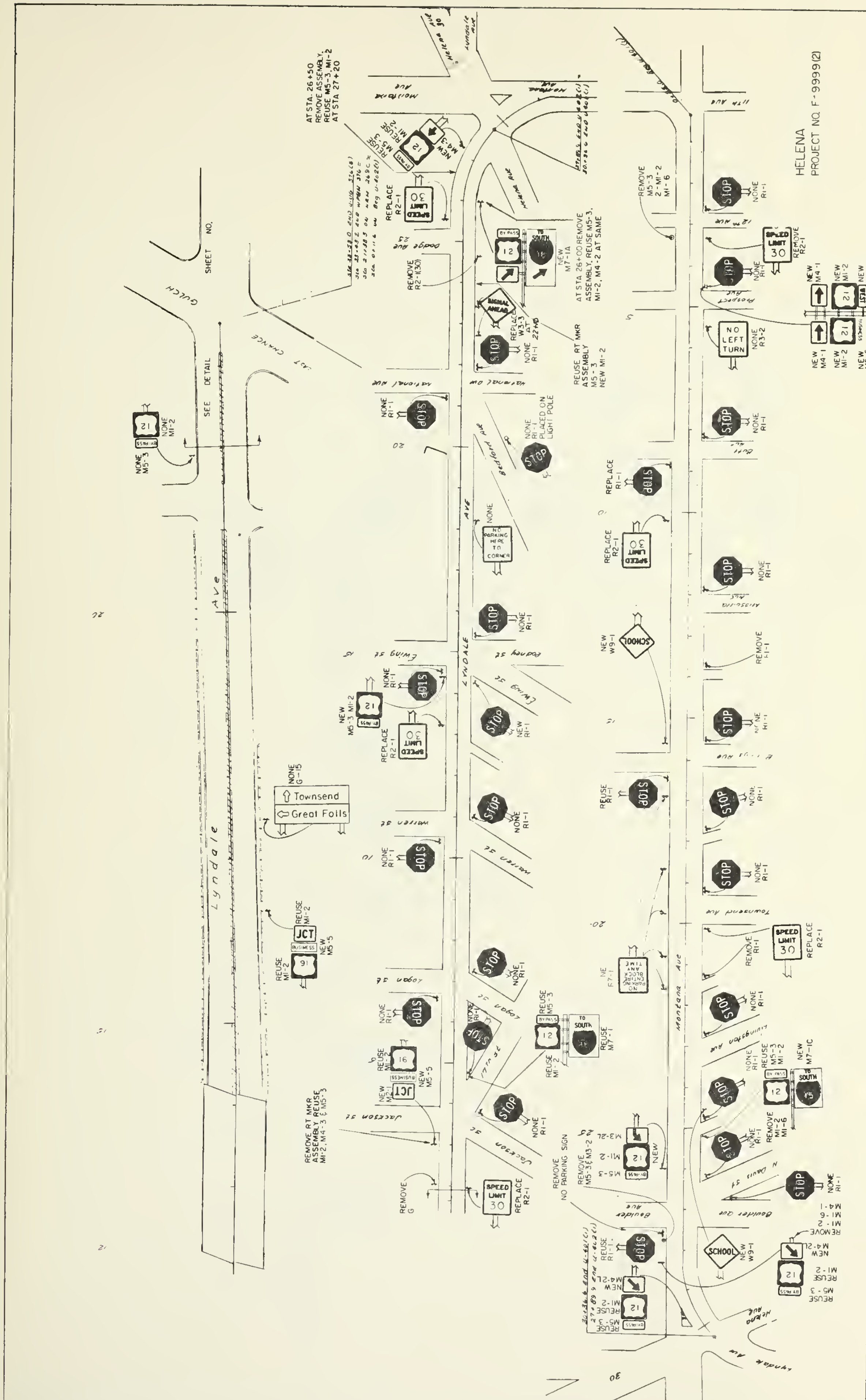

HELENA
PROJECT NO. F-9999(2)
SHEET NO.
SEE DETAIL
Townsend
Great Falls
Lyndale Ave
Montana Ave

FIGURE 5

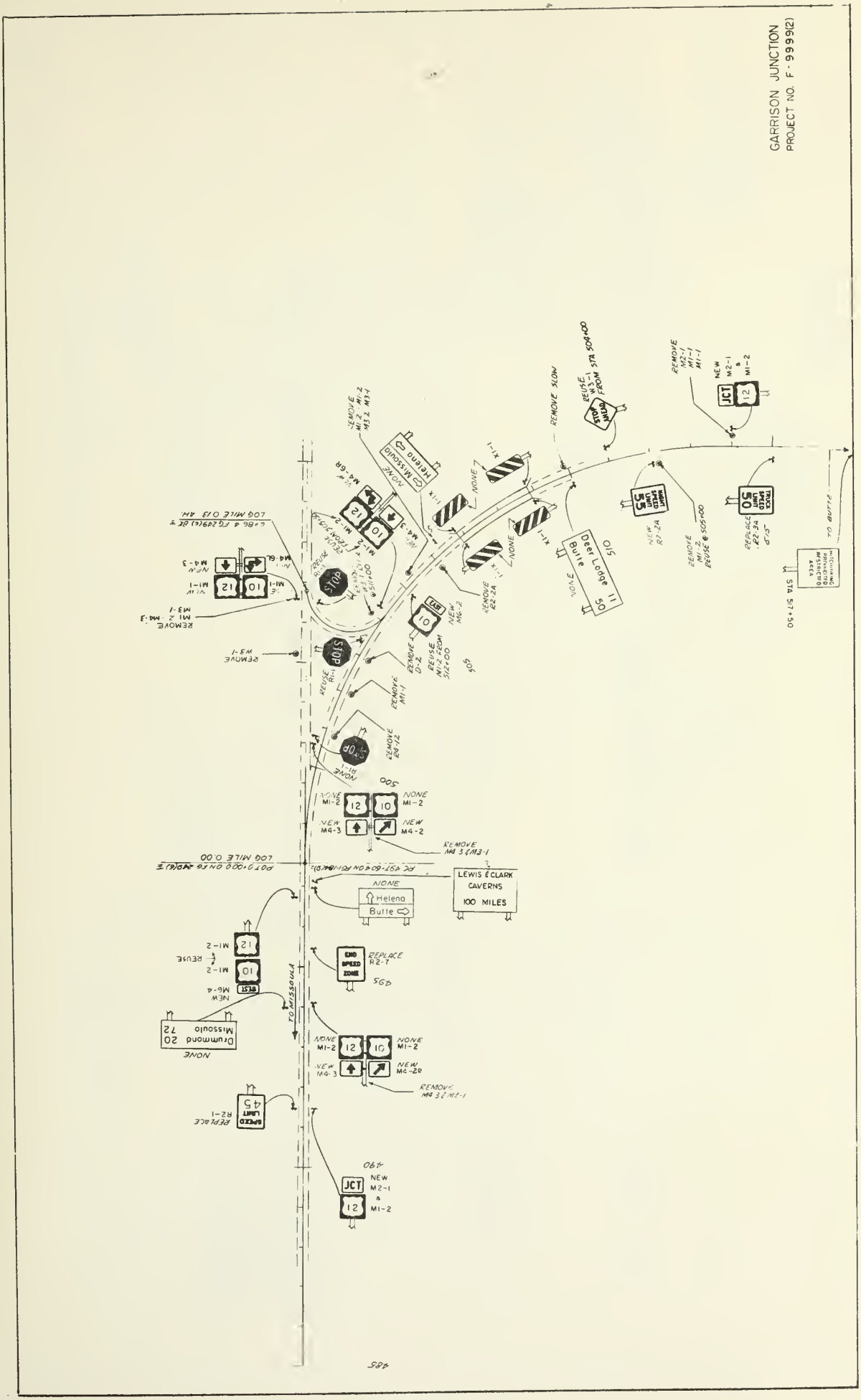
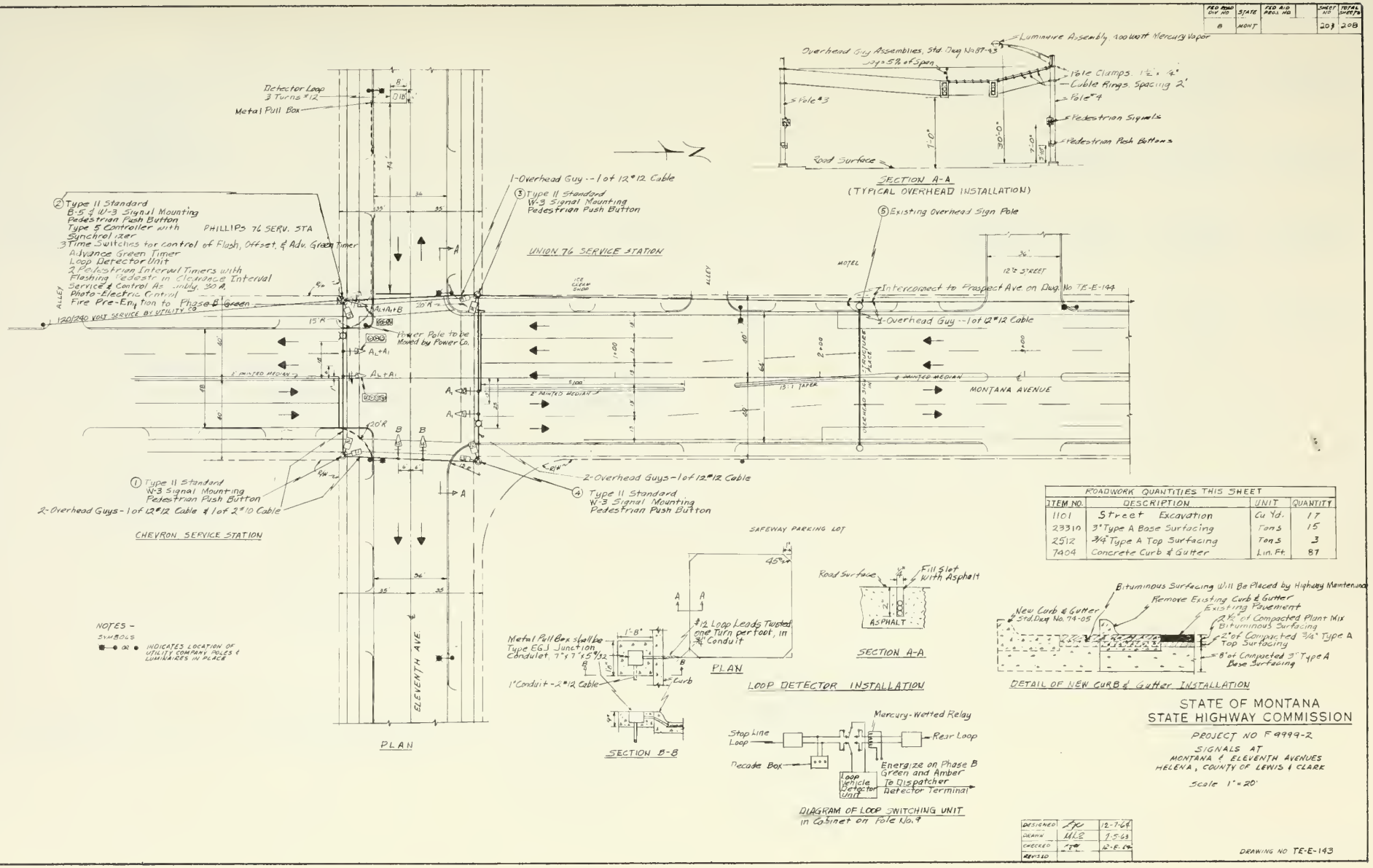

GARRISON JUNCTION
PROJECT NO. F - 9999(2)
REMOVE SLOW
REUSE M3-1 FROM STA 504+00
REMOVE M2-1 M1-1
NEW M2-1 & M1-2
JCT 12
REMOVE M1-2 M3-2 M3-1
Helena Missoula
NONE
M4-6R
NEW M2-1 & M1-2
JCT 12
NEW R2-2A
REMOVE M1-2 REUSE @ 505+00
REPLACE R2-3A R2-5
TO BUTTE
STA 517+50
Deer Lodge 11 Butte 50
0/5
NONE
REMOVE R2-2A
REMOVE M1-2 M3-2 M3-1
REUSE M1-2 FROM STA 504+00
REMOVE M1-2 M3-2 M3-1
REMOVE M1-1
REMOVE M3-1
REMOVE M1-1
REMOVE R4-12
REMOVE M3 & M3-1
LEWIS & CLARK CAVERNS 100 MILES
Helena Butte
REPLACE R2-1
END SPEED ZONE
NEW M6-4
Drummond 20 Missoula 72
REPLACE R2-1
LIMIT 45
NEW M2-1 & M1-2
JCT 12
LOG MILE 0.00
LOG MILE 0.13 AH
STOP
OP
485
490
495
500
505

FIGURE 6

FIGURE 7



ROADWORK QUANTITIES THIS SHEET			
ITEM NO.	DESCRIPTION	UNIT	QUANTITY
1101	Street Excavation	Cu Yd.	17
23310	3" Type A Base Surfacing	Tons	15
2512	3/4" Type A Top Surfacing	Tons	3
7404	Concrete Curb & Gutter	Lin. Ft.	87

FED ROAD DIV NO.	STATE	FED AID PROJ NO	SHEET NO	TOTAL SHEETS
8	MONT		208	208

STATE OF MONTANA
STATE HIGHWAY COMMISSION

PROJECT NO F 9999-2

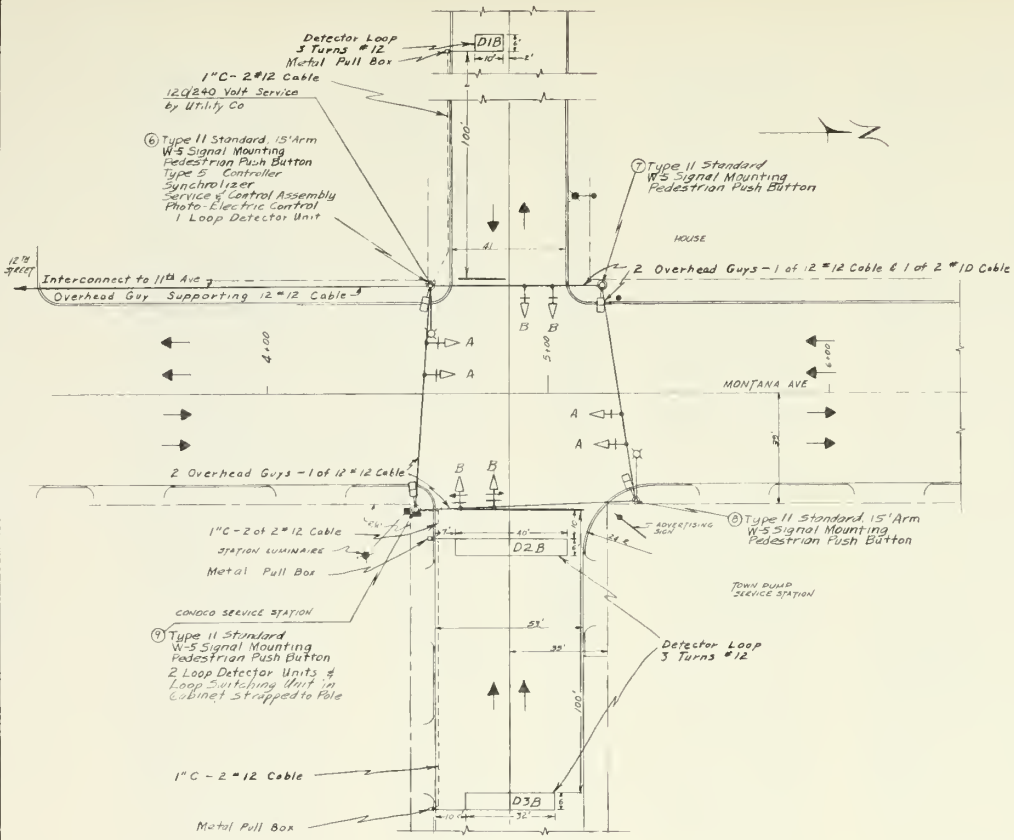
SIGNALS AT
MONTANA & ELEVENTH AVENUES
HELENA, COUNTY OF LEWIS & CLARK

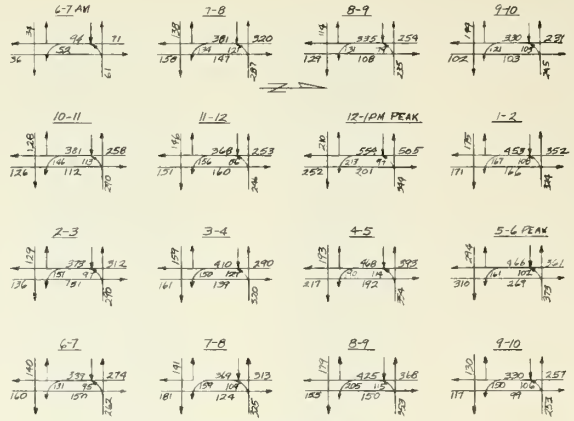
Scale 1" = 20'

DESIGNED	JPK	12-7-68
DRAWN	MLZ	1-5-69
CHECKED	JPK	2-5-69
REVISED		

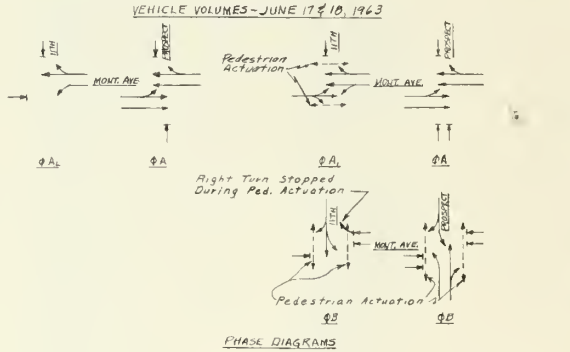
DRAWING NO TE-E-143

FIGURE 7A





VEHICLE VOLUMES - JUNE 17 & 18, 1963

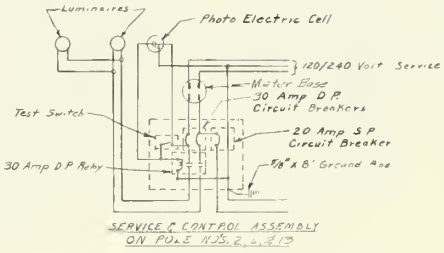


PHASE DIAGRAMS

POLE SCHEDULE										
IDENT NO	STANDARD DWG NO	ITEM NO.	TYPE	SIZE	GAUGE	MAST ARM SIGNAL	MAST ARM LENGTH LIGHT	ANCHOR BOLT* SIZE	ANCHOR BOLT* CIRCLE	CONCRETE FOUNDATION
1	87-11A		11	11"X 7 X 28'	3		15'	1¾"X90°	15"	3'6" X 7'
2	"		"	"	"			"	"	"
3	"		"	"	"		15'	"	"	"
4	"		"	"	"			"	"	"
5	"		"	"	"		15'	"	"	"
6	"		"	"	"			"	"	"
7	"		"	"	"		15'	"	"	"
8	"		"	"	"			"	"	"
9	"		"	"	"			"	"	"

*A: Anchor bolts shall protrude 8" above foundation surface.

SPAN & SAG SCHEDULE			
From	To	Approx. Dist - Ft	SAG - Inches
1	2	76.0	46.0
2	3	66.0	40.0
3	4	81.0	49.0
4	1	66.0	40.0
3	5	186.5	45.0
5	6	238.5	57.0
6	7	61.5	37.0
7	8	77.5	46.5
8	9	78.5	47.0
9	6	80.0	48.0



SERVICE & CONTROL ASSEMBLY ON POLE N.J.S. 2, 4, & 13

STATE OF MONTANA
STATE HIGHWAY COMMISSION

PROJECT NO. F 9999-2

SIGNALS AT
MONTANA & PROSPECT AVENUES
HELENA, COUNTY OF LEWIS & CLARK

Scale 1" = 20'

DESIGNED		12-7-64
DRAWN		7-5-65
CHECKED		12-8-64
REVISED		

DRAWING NO. TE-E-144

NO. BRIDGES DIV. NO.	STATE	NO. R-O-W SERIAL NO.		SHEET NO.	TOTAL SHEETS
8	MONT.			205	208

EXCERPTS FROM A.A.S.H.O. PAMPHLET: "PURPOSE AND POLICY IN THE ESTABLISHMENT AND DEVELOPMENT OF UNITED STATES NUMBERED HIGHWAYS." REVISED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS JANUARY 1, 1959.

Established Policies

1. The Executive Committee of the American Association of State Highway Officials shall have full authority to review the U.S. numbered road system and the numbering and marking thereof, to make additions, changes, extensions, revisions or reductions in said road system and to revise the numbering or marking thereof.

2. Before approving any addition, change, extension, revision or reduction in the U.S. numbered road system, or the numbering or marking of any U.S. numbered road, the Executive Committee shall consult the State Highway Department of the State or States through or within which such addition, change, extension, revision or reduction is located.

3. The State Highway Department, by a favorable vote on the adoption of this program and policy, agrees and pledges its good faith that it will not erect U.S. markers on any road or take down or change the U.S. markers on any road without the authorization, consent or approval of the Executive Committee of the American Association of State Highway Officials, notwithstanding the fact that the changes proposed are entirely within that State.

4. No additional road shall be added to the U.S. numbered road system, and no existing U.S. road shall be extended except where there is a definite showing of an adequately improved highway carrying an established and necessary line of interstate traffic not otherwise provided for by existing U.S. routes and for which traffic adequate service cannot be provided by State route numbers.

Extension of present U.S. numbered routes may be made only when the proposed extension is in the general direction of the present route.

Proposed extensions shall not be made when, to do so, it is necessary to duplicate U.S. routes already established, unless the duplication is for a short distance and the routes then diverge, ending in different terminal points.

5. No new U.S. route located wholly in one State shall be established. U.S. routes, less than three hundred miles in length, heretofore established and located wholly in one State, shall be eliminated either by consolidation with other U.S. routes or by reverting to State routes, as rapidly as the State Highway Department and the Executive Committee of the American Association of State Highway

Figure 8

Officials can reach agreement with reference thereto.

6. The Executive Committee shall encourage the State Highway Departments in the development of continuous State route numbers extending into two or more States rather than the establishment of additional U.S. numbered routes, and shall encourage the substitution of continuously numbered State routes for relatively short U.S. routes now located in two or more States.

7. No new divided numbers (such as U.S. 96-W and U.S. 96-E, etc.) shall be adopted. Existing divided U.S. numbers shall be eliminated as rapidly as the State Highway Department and the Executive Committee can reach agreement with reference thereto.

8. Existing U.S. routes shall be consolidated, improved and shortened.

(a) By connecting two or more relatively short routes into one longer route.

(b) By relocating portions of existing routes so as to follow newer, better or shorter roads.

(c) By the establishment of new numbers, following in general existing U.S. numbered routes, but taking advantage of new roads or short cuts where the changing of present numbers is not practical.

9. A suitable highway legend, which may by copyrighted, shall be adopted by the Executive Committee. Such legend will be recommended for use to all travel map makers, also for use by the State Highway Departments. This legend is to show, in a uniform manner, the suitability for travel, not only of the U.S. numbered routes, but also of State routes.

10. Any proposal that would exploit the prestige of the U.S. numbered highway system to direct traffic over routes that are not the shortest and best available between major control points on the system, expecially when it appears to be for the purpose of benefiting businesses located along such a proposed route, shall constitute reason for denying any application to make such an addition to the system.

11. Since the U.S. numbered system was established by joint action of the State Highway Departments, only those applications for changes in or additions to the U.S. numbered system from the Member State Highway Department involved shall be considered by the Executive Committee. Those local officials, organizations, groups, or individuals interested in a change or in an addition to the system should contact their State Highway Department and not the Executive Committee. The Executive Committee shall consider only those applications from State

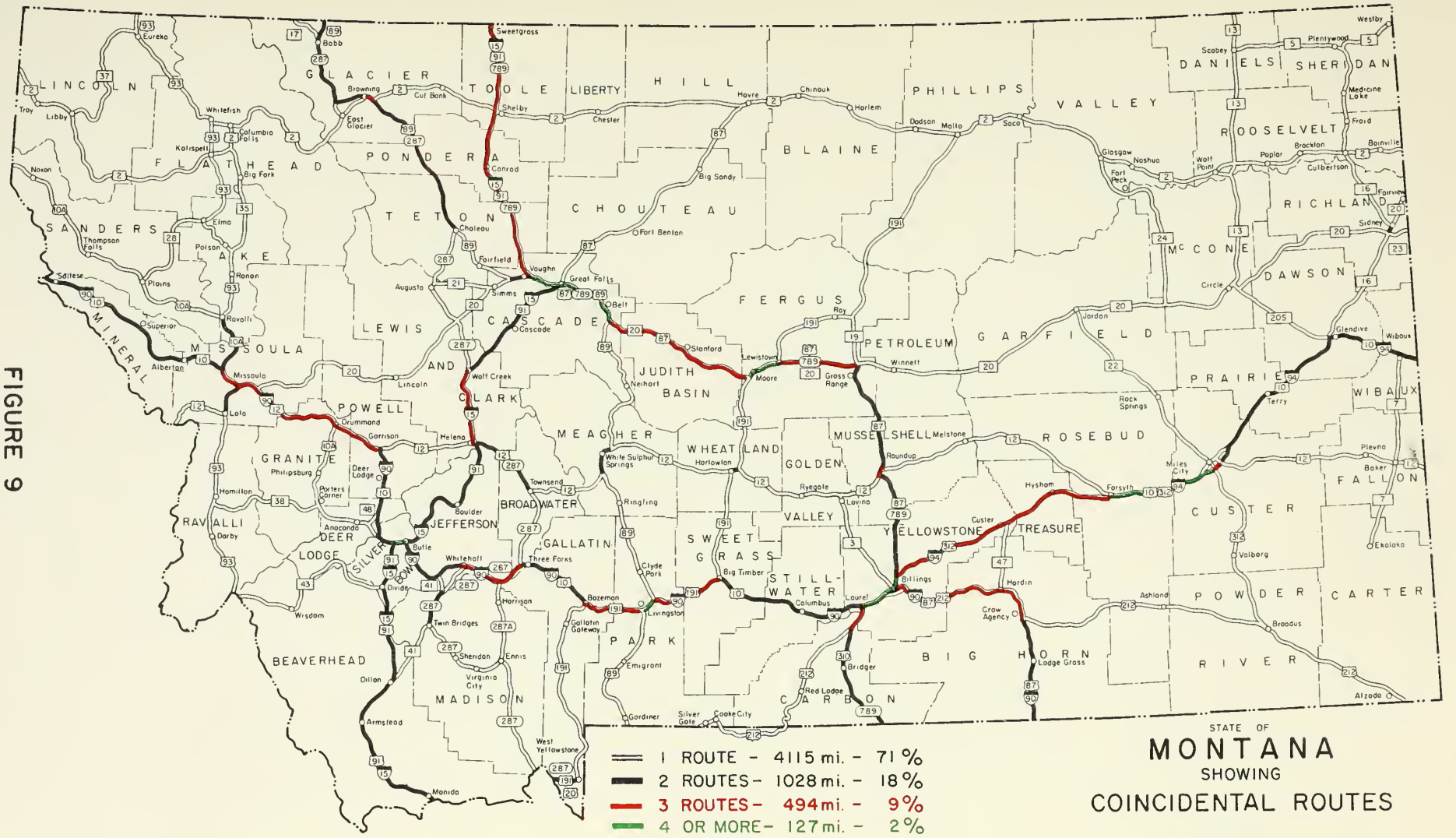
Highway Departments that are filed on the official form and are complete in all detail to the degree that the Executive Committee can evaluate the need for and adequacy of the proposed route from the application form submitted and without a representative of the State Highway Department appearing before the Committee to supply additional information.

12. No person or group of persons shall be allowed to appear either before the Executive Committee or its Route Numbering Subcommittee except in the case of a State Highway Department requesting reconsideration of an action by the Executive Committee in regard to an application filed by that Department.

13. In case a proposed change in or addition to the U.S. numbered system involves two or more States, the proposal shall be given official consideration only when all affected State Highway Departments have filed applications to cover the complete proposal.

14. No route should be considered for inclusion in the U.S. numbered system that does not substantially meet the current AASHO design standards for Primary Highways.

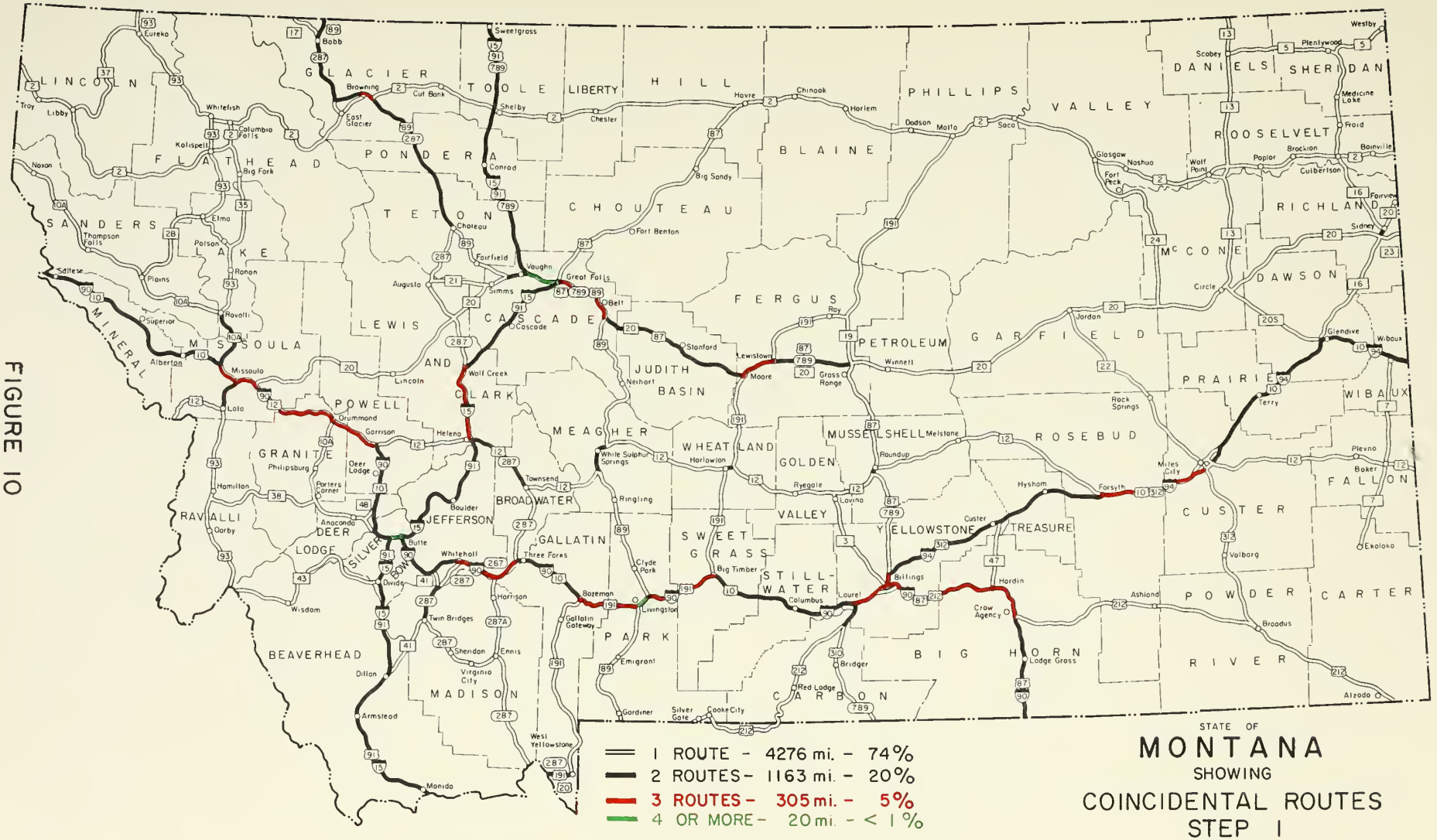
Figure 8B



1 ROUTE - 4115 mi. - 71 %
2 ROUTES - 1028 mi. - 18 %
3 ROUTES - 494 mi. - 9 %
4 OR MORE - 127 mi. - 2 %

STATE OF
MONTANA
SHOWING
COINCIDENTAL ROUTES

FIGURE 9

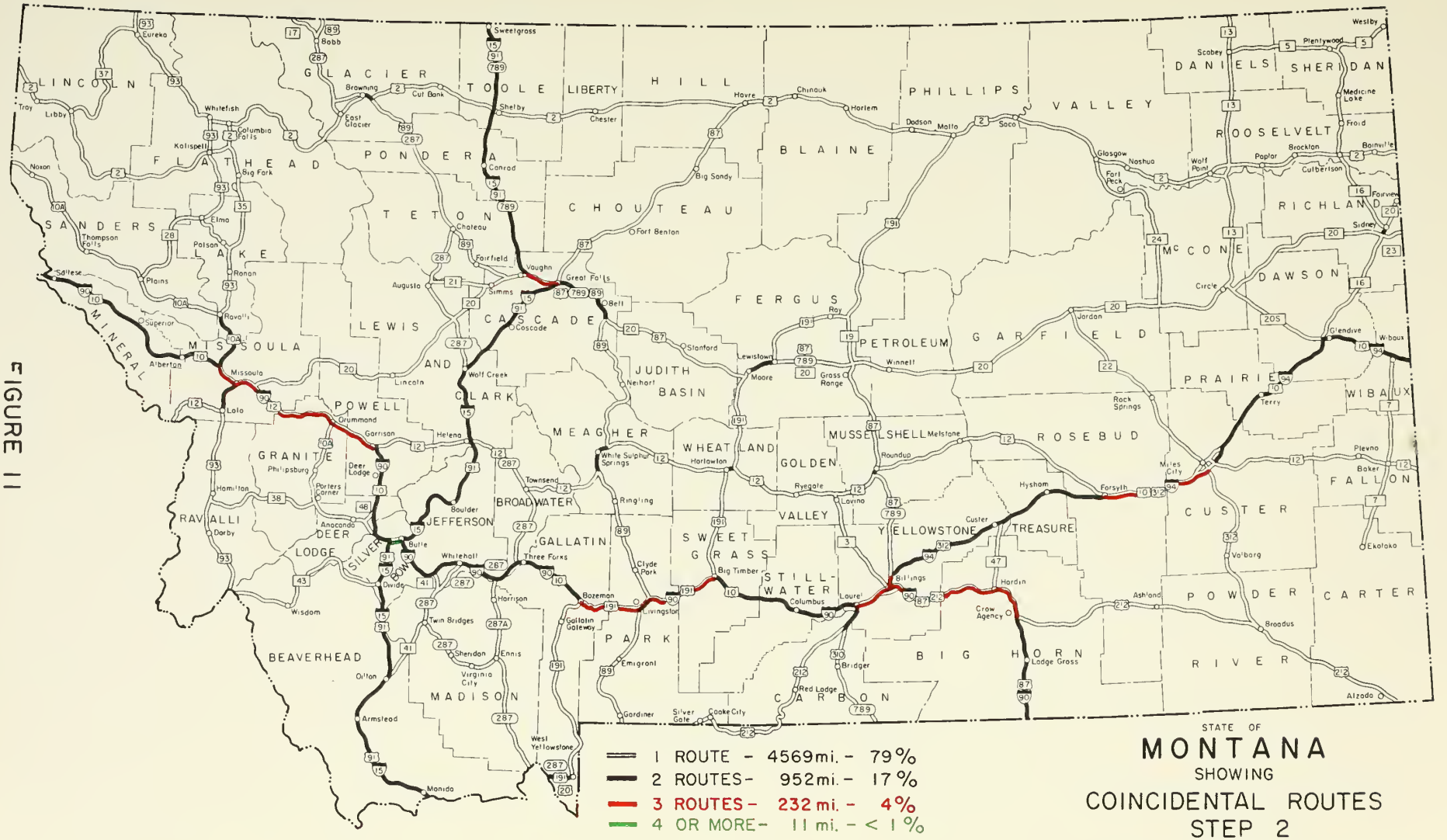


1 ROUTE - 4276 mi. - 74%
2 ROUTES - 1163 mi. - 20%
3 ROUTES - 305 mi. - 5%
4 OR MORE - 20 mi. - < 1%

STATE OF
MONTANA
SHOWING
COINCIDENTAL ROUTES
STEP 1
ELIMINATE MONT 789 & US 312

FIGURE 10

FIGURE 11

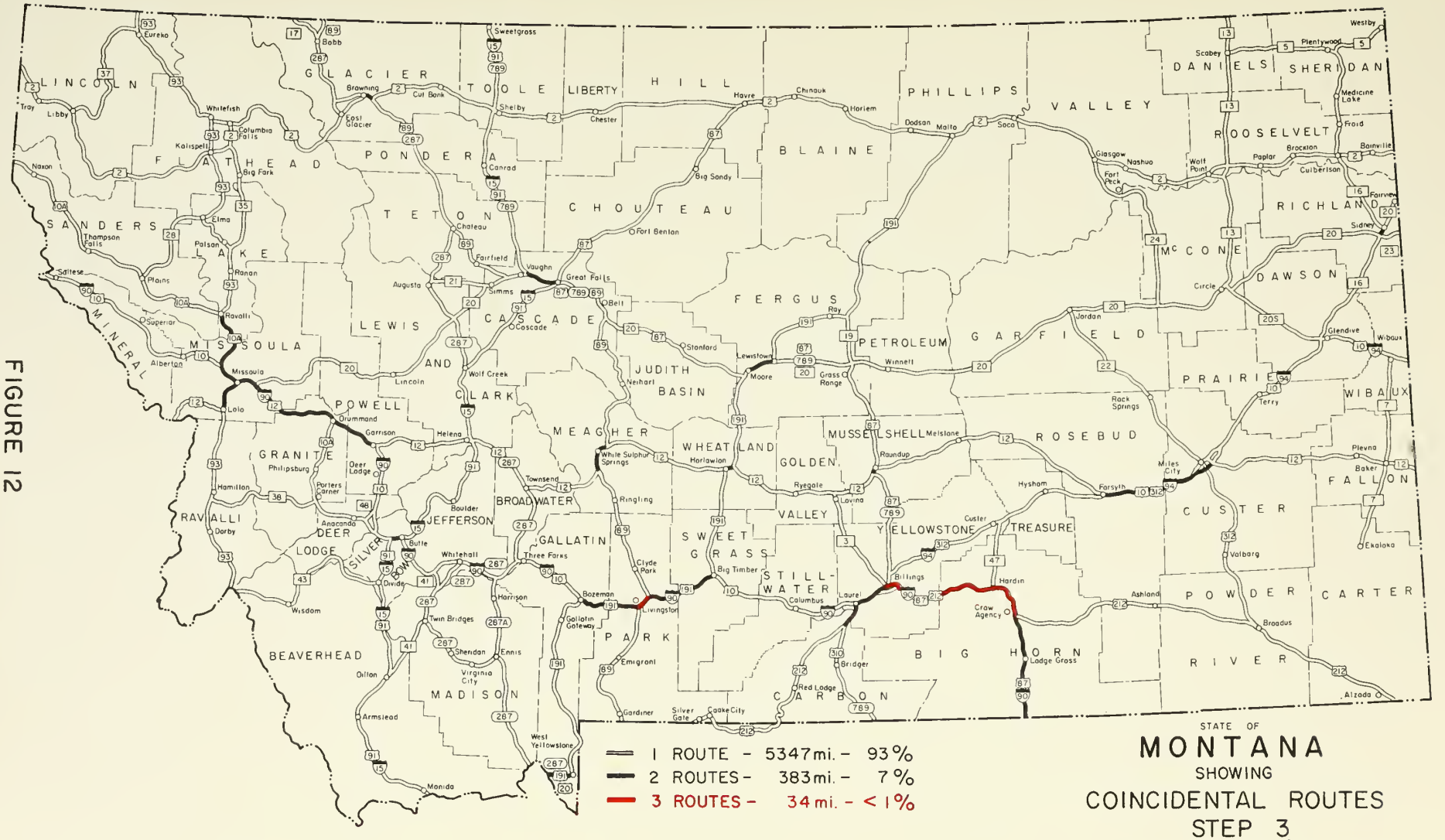


1 ROUTE - 4569mi. - 79%
2 ROUTES - 952mi. - 17%
3 ROUTES - 232 mi. - 4%
4 OR MORE - 11 mi. - < 1%

STATE OF
MONTANA
SHOWING
COINCIDENTAL ROUTES
STEP 2

DISCONTINUE MONT 20 & 287
WHERE COINCIDENT WITH
I OR US ROUTES

FIGURE 12



STATE OF

MONTANA

SHOWING

COINCIDENTAL ROUTES

STEP 3

EVENTUAL ELIMINATION OF US 10 & US 91 WHERE COINCIDENT WITH I ROUTES